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BY

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NASAL BACTERIA IN HEALTH.*

By JONATHAN WRIGHT, M. D.,
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The position which micro-organisms will ultimately take in their relation to the morbid processes of disease has not been determined as yet. Indeed, we seem now only at the beginning of an unknown region in which possibly lies hidden the mystery of the ætiology of many pathological changes. Encouragement in the region of preventive medicine, under which head we must include all that Listerism has done for surgery, lends zest to the attempts to follow the microbe into the human organism and there annihilate it. The almost complete failure thus far has given professional cynics an opportunity for a somewhat galling criticism. These failures are, no doubt, in a large measure due to our as yet very incomplete knowledge of the varying conditions and influences which complicate the relations of microbes to the human organism. Whatever opinion the clinician may have of the part played by them in the ætiology of the diseases he observes, even the most skeptical must admit that the burden of disproof has been thrown upon the doubters.

* Read before the Laryngological Section of the American Medical Association at its fortieth annual meeting.

With the increased probability that many pulmonary and nasal diseases owe their origin, in a large degree, to micro-organisms, it becomes important that the bacterial contents of the respiratory tract in a state of health should be known. Before we are in a position to investigate a pathological process we must have a firm physiological basis on which to stand. Before we seek for a pathogenic micro-organism in disease we should know what exists in the situation in a condition of health. The ingress of all infective agents must, in the vast majority of cases, be through the nose or the mouth; those of the respiratory tract, as a rule, through the former; those of the alimentary tract, as a rule, through the latter. The bacterial contents of the mouth in health have been so thoroughly investigated by Biondi (1), Vignal (2), Netter (3), Fraenkel (4), and others that further researches would seem superfluous when our knowledge of the nasal micro-organisms in health is so slight. As laryngologists we are becoming more and more impressed with the necessity of normal nasal respiration and the harm of mouth breathing. In the further advance of nasal bacteriology we may find another reason to urge the importance of purely nasal respiration. When we remember the apparatus of Hesse (5) for air analysis, the configuration of the internal nose would seem admirably adapted to arrest the progress of microbes carried into it by the air current; and, still further, it has been conclusively proved that bacteria never rise from a damp surface, however strong the blast may be over it, unless carried along by some particle of water or mucus or solid matter. Hence we should expect to find innumerable varieties of bacterial forms derived from the air, and might well despair of reaching any definite conclusions in the matter. Besides the bacteria of phthisis and pneumonia and the microbe of diphtheria, whether it be the bacillus of Löffler or the streptococcus of Prudden, there

seems good evidence that some purely intranasal diseases depend upon micro-organisms for their origin or their subsequent course. A perusal of the researches of Löwenberg (6), Klammann (7), Thost (8), Seifert (9), Strauch (10), Valentin (11), Hajek (12), Reimann (13), and others into the ætiology of ozæna and coryza must convince us of the truth of what Walb (14) says of ozæna.

"I am convinced," he says, "that the way opened by Löwenberg will lead to the discovery of the nature of ozæna. Whether the Löwenberg coccus or some other is the cause of ozæna is of no consequence; it must exist, and it is to be hoped that it will be found."

Whether there is a bacterial connection between coryza and pneumonia, as maintained by Thost (8), and further urged by Cardone (15), it is impossible, with our present knowledge, to form any opinion.

Notwithstanding the abundance of the literature to be found on the bacteria of nasal diseases, there is very little, in fact no systematic examination of the normal nasal secretions for bacteria recorded in the somewhat extended range of literature to which I have had access. However instructive the staining of nasal secretions for bacilli and cocci as a matter of technique may be, there is little or nothing else to be learned from it without the aid of the improved methods of cultivation tests. I have therefore omitted extended reference to this class of work. The mere presence of micro-organisms in nasal secretions was established many years ago. Bernard Fraenkel, in von Ziemssen's "Encyclopædia" in 1876, in his article on acute coryza, says:

"A large number of these little structures, recently so much spoken of and called micrococci, may generally be seen also covering the cells."

And he refers to Hueter (16) as maintaining these bodies to be the source of irritation in coryza. Herzog (17) in 1881

found many bacilli and cocci in normal and abnormal nasal secretions, more abundant in the latter, and especially in fœtid nasal catarrh. Eugen Fraenkel (18), on the other hand, in 1882 stated that he could find no bacteria in the normal nose, and his work on ozæna, in the secretions of which he found four kinds of bacteria, has been widely quoted, but, in the light of our present bacterial knowledge, possesses on this point only historical interest. Later observations have all been made incidentally in connection with bacterial investigations of disease. Bernard Fraenkel (19) in 1886 found in the normal pharynx, besides the *Staphylococcus pyogenes aureus* and the *Staphylococcus pyogenes albus*, a micrococcus which often appeared as a diplococcus and did not liquefy gelatin. Probably the same coccus was found in the normal retro-pharynx by Hack (20), and fully described by his pupil Strauch (20). The latter asserts that it is also found in the nose, but less frequently and in smaller numbers. Both Löwenberg (6) and Hajek (12) failed to find micro-organisms at all constant or abundant in normal nasal secretions. Reimann (13), on the other hand, described two forms as nearly always found—one a plump round-ended bacillus, and the other a little coccus which occurred usually in pairs but often in longer chains. Considering the extensive and very thorough work done upon the bacterial contents of the mouth in health, it is singular that there should be such a lack of it in the nose.*

* At the last meeting of the Russian congress in St. Petersburg, Besser reported having examined the nasal secretions of 81 patients, the bronchial secretions of 10, and the secretions of the frontal sinuses in 5. Out of the nasal and bronchial secretions he cultivated the Fraenkel-Weichselbaum diplococcus of pneumonia in 14 cases, the *Staphylococcus pyogenes aureus* in 14 cases, and the *Streptococcus pyogenes* in 7 cases. Unfortunately, I have not been able to procure the

My own observations have been made during the last two years in the laboratory of the Alumni Association of the College of Physicians and Surgeons under the direction of Dr. T. M. Prudden, to whose kindness and careful oversight the little which may be of value in them is due. The material was drawn from the Dispensary of the Roosevelt Hospital. Although a number of other cases were examined, it is my purpose to record here only those investigations made in fairly normal cases, leaving the examinations in the other cases for further amplification and another occasion. The method of work was as follows: Portions of the nasal secretion were removed from the mucous membrane covering the turbinated bones and adjacent portions of the septum, in the loop of a long platinum needle previously sterilized in the flame. This was immediately plunged into two gelatin tubes, and streak cultivations were made upon two agar-agar plates. Thus, four inoculations were made from different portions of the nasal chambers in each case. Besides this, a number of dry cover-glass preparations were made of the nasal secretion in each case and stained by Gram's method and by simple double staining. These last frequently showed no bacteria when the cultivation tests proved their presence in great abundance. The gelatin tubes were plated according to Koch's method and pure cultivations obtained and transferred to cultivation-media tubes of agar-agar, five-per-cent. glycerin-agar, gelatin, bouillon, milk, and potatoes. The same was done with pure cultivations obtained from the streak cultivations on the agar plates. The growth characteristics were noted and compared with descriptions in the works of Flügge, Fraenkel, Eisenberg, and others, and where close correspondence was observed their denomina-

original article, and the reference in the "Centralblatt für Bacteriologie," Bd. v, No. 21, is incomplete, not giving the conditions under which they were found.

tions were accepted. Those forms found not to correspond to any descriptions were, as a rule, carefully worked out and the records preserved, but it is unnecessary to describe them here, as they were only found in isolated cases. All the usual precautions were taken against contaminations and, in addition, only those colonies selected from the plates which were in sufficient numbers to preclude the possibility of contamination and to eliminate, as far as possible, those microbes which had only recently become nasal inhabitants and had not yet grown in the nasal secretions to any considerable numbers.

When one remembers the multitude of air bacteria which would naturally lodge against the nasal mucous membrane, and be only accidental visitors to a soil unsuited to them, this precaution will not seem uncalled for. In all cases care was taken to ascertain that no nasal douches of any kind had been previously used. Any one, even those unfamiliar with the technique of bacterial analysis, will appreciate the amount of work required where so many different forms had to be carefully worked out, and that may be pleaded as an excuse for the limited number of cases brought forward. In the ten cases mentioned, the condition of the mucous membrane was as nearly normal as possible, and even where insignificant changes were observed they are noted. The class of cases was not so diversified as would be desirable, as they were all in dispensary patients. I made several bacterial analyses of the air of the dispensary from time to time by Petri's and Sedgwick's methods and by exposure of agar plates. At no time was there any growth but those of simple air bacteria noted. The nasal bacterial forms were found to vary markedly with the state of the weather and of the streets. High winds and dry and dusty streets were sure to fill the noses with air bacteria. In rainy weather, or after several days of calm, or when snow

was on the ground, aerial forms were much more rare. It seems to me there can be only one cause for this—viz., they tend to disappear because they have found a soil unfitted for their growth, and, according to the universal law of natural selection, give way to microbial forms more favored by the conditions. It certainly is not because they flow away in the secretions, because it is not only their absolute frequency which varies, but their frequency relative to other forms. The reaction of the secretion of the normal nose was found to be neutral or slightly alkaline.

Case I.—A young man in fair health, with the exception of slight cough. No pulmonary lesion; slight hypertrophy of one turbinated bone; nose otherwise normal. A short, plump bacillus looking at times like a diplococcus; slow white growth on gelatin which it does not liquefy. Same on agar, spreading slightly on surface.

Case II.—A young girl with slight tonsillar enlargement; nose normal; general health good. Bacterial analyses were made on three separate occasions, and twice was found a nearly pure cultivation of the *Staphylococcus pyogenes aureus*. The tonsils were examined and the same growth was found there. Inoculations of pure bouillon cultivations in the jugular of rabbits set up purulent pericarditis and endocarditis, of which the animals died. The pus swarmed with the cocci.

Case III.—A boy of seventeen who had a perforation of the septum and hard palate from a syphilitic process. All ulceration had long healed and the mucous membrane was normal in appearance. The *Staphylococcus pyogenes aureus* was found in large numbers and a moderate growth corresponding to the *Bacillus lactis aerogenes*.

Case IV.—A man of thirty-five, who a few weeks previously had been discharged from Roosevelt Hospital after a severe operation for the removal of a thyreoid tumor. The wound had healed by first intention. Left laryngeal paralysis resulted. The nose was perfectly normal in every way. The *Staphylococcus pyogenes aureus* and *albus* were both found, and abscesses

were caused by the injections of pure bouillon cultivations of each beneath the skin of rabbits. From these abscesses new cultivations of the same growths were obtained in each case.

Case V.—A child ten years old. No subjective nasal symptoms, but the mucous membrane of the nose was slightly hyperæmic. In this case also both the *Staphylococcus aureus* and *albus* were found, and positive results obtained from animal inoculations.

Case VI.—A seamstress, aged sixteen. She had had considerable post-nasal catarrh, but no purulent secretion. Nose normal and health good. Two examinations six weeks apart were made. Each time in the nares there was found an abundant growth of the ordinary mold, the *Penicillum glaucum.* Each time pure cultivations of the *Streptococcus pyogenes* were obtained from the post-nasal space. A pure bouillon cultivation was injected beneath the skin of rabbits' ears and an erysipelatous inflammation produced, from the sanious pus of which cover-glass preparations were made showing abundant cocci in chains. At the second examination a cultivation of a gas-producing bacillus was also made from the tonsils. The most careful questioning could elicit no history of exposure to contagion of any kind. She herself was in the best of health except for the discomfort from her post-nasal catarrh.

Case VII.—A girl, aged sixteen, cigarette-maker. There was slight hypertrophy of the nasal mucous membrane with some tonsillar injection. The *Staphylococcus pyogenes citreus* was found in the nose.

Case VIII.—A child, aged four. Slight post-nasal catarrh and slightly enlarged tonsils. Nose normal. In it was found the *Micrococcus flavus desidens.*

Case IX.—A man, aged nineteen, with follicular amygdalitis and post-nasal catarrh. This case presented considerable structural change, and I insert the record here because, in spite of the large amount of secretion present, only aerial forms were found. They were the *Micrococcus flavus desidens* and *Micrococcus cereus flavus*, and an undetermined coccus with a curious growth on agar and gelatin, a description of which would be out of place here.

CASE X.—A woman, aged twenty, with a slight attack of laryngitis. She was recovering from coryza and there was some mucous secretion in the nose. The bacterial contents were as follows:

1. *Staphylococcus pyogenes aureus.*
2. *Micrococcus flavus desidens.*
3. A tetrad resembling closely the descriptions of the *Micrococcus tetragenus.*
4. An undetermined coccus, with a white non-liquefying growth on gelatin and agar.

The three last cases were examined during windy, dusty weather, and illustrate well, especially in the last case, the unreliability of cover-glass preparations alone of the nasal secretions in determining bacterial species, as the morphological appearance in four out of the five organisms was the same.

To summarize: In six cases, the *Staphylococcus pyogenes;* in three cases, the *Micrococcus flavus desidens;* in one case, the *Bacillus lactis aerogenes;* in one case, the *Penicillum glaucum;* in one case, the *Micrococcus cereus flavus;* in one case, the *Micrococcus tetragenus;* once in each of three cases, different undescribed forms.

CASES.	Staphylococcus pyogenes aureus, albus, and citreus.	Micrococcus flavus desidens.	Bacillus lactis aerogenes.	Penicillum glaucum.	Micrococcus cereus flavus.	Micrococcus tetragenus.	Different undescribed forms.
I							1
II	1						
III	1		1				
IV	1						
V	1						
VI				1			
VII	1	1					
VIII		1					
IX					1		1
X	1	1				1	1
Total	6	3	1	1	1	1	3

The air forms may be dismissed without further consideration. The *Micrococcus tetragenus*, found in only one case and in small numbers, need only receive a passing mention. In Case VI the only organism in the nasal chambers proper which was made out by two careful examinations at different periods was the ordinary mold—the *Penicillum glaucum*. It was in such great numbers that it possibly may have overshadowed the growth of other forms. Considering its great aerial frequency, it is singular that it was not oftener found. In this case the *Streptococcus pyogenes* was twice found in the naso-pharynx, which was the seat of a chronic catarrhal inflammation, but which showed few changes in the mucous membrane besides the reddening of the surface and the increased secretion of mucus. For its pathogenic significance in the air-passages the works of Netter (3 and 22), Prudden (21), and others may be referred to.

Our attention is therefore directed to the *Staphylococcus pyogenes;* the three varieties *aureus*, *albus*, and *citreus* need only be considered as one in their pathogenic significance. We know as yet too little concerning the conditions under which this organism exerts its characteristic influence to draw conclusions. It may be well, however, to refer to the statements of a few of the various workers in this field.

Ullmann (23) found the staphylococcus in the air in different situations and under varying conditions, as well as in the water of the river Spree. He and others found it in the earth, on the streets, and on the walls of various rooms and buildings. As to man, he says: "Fürbringer found it in the dirt under finger-nails, and Bumm in the folds of the nipples. Biondi obtained cultures of it from the saliva, and Fraenkel from the tonsils. I have found it not only on the buccal mucous membrane, in the saliva, the tonsils, the pharynx, and vagina of healthy people and of animals, but

in the œsophagus, intestinal tract, and bladders of recently killed animals. Lustgarten and Mannaberg found it constantly in the urethra. These investigations show that the staphylococcus is very widely distributed, and that it is found wherever living beings are."

From this we see that its very frequent occurrence in the nose forms no exception to the rule. It will require investigation of many more cases than those here cited to prove that it is the most frequent and abundant micro-organism in the nasal chambers. Netter (22), speaking of the influence of pathogenic micro-organisms in the mouth, nose, and ears, says: "The presence of the microbes is not enough. It is necessary that they should be present in sufficient quantity to triumph over the resistance which healthy anatomical structures offer them. It is necessary that their virulence should be sufficiently great, and we know that their virulence is not always the same."

He might have also said that the resistance offered them was not always the same. On this head the work of Bujwid (24) is suggestive. He found that, in round numbers, a billion *Staphylococci aurei* for a rabbit, a hundred millions to a billion for a rat, and a hundred millions for a mouse, could be injected beneath the skin of a healthy animal without result, no abscess forming. When, however, grape-sugar had been previously introduced into the animals' systems, they succumbed.*

Ribbert (25) and his pupils, Fleck (26) and Laehr (27), caused a catarrhal inflammation of the bronchi, with more or less broncho-pneumonia, by injections of pure cultiva-

* Since this paper was written, the very valuable papers of Buchner ("Ctrlbl. f. Bact.," iv, 25, v, 1) and Nissen ("Ztschr. f. Hygiene," vi, 3) have come under my observation. They give convincing proof that it is the albumin in the blood plasma that exercises the destructive influence on bacteria in the circulation.

tions of the staphylococcus into the trachea. Their investigations, as well as those of Wyssokowitsch (29), tend to show that the lungs or the adjacent bronchial lymphatic glands act as a sort of filter or as a place of destruction for the microbes, preventing their further penetration into the human organism.

Prudden (21) repeated the experiments of Fleck and Laehr, with like results. He also succeeded in causing broncho-pneumonia by injections of pure cultivations of the *Streptococcus diphtheriæ* and by injections of ammonia.

Lübbert (28) caused fibrino-purulent tracheitis and bronchitis by injections of a pure cultivation of the staphylococcus into the trachea. It is asserted by many investigators, and their assertions are based upon extensive experiments, that it is the pavement epithelium which prevents the entrance of various microbes into the subjacent structures and thence into the general system. The very general experience of laryngologists would hardly bear this out as regards the staphylococcus, since tonsils and uvulæ are cut without a fear of septic invasion, and in all the operations upon the mucous membranes of the mouth and nose this is the least danger we fear. If, however, a patient bites the operator's finger so as to break the skin, unless the wound is thoroughly washed out with an antiseptic, local suppuration often follows, and, occasionally, from this general sepsis.

I have mentioned these facts and observations in order to show how little we know as yet and how vastly much more we have to learn about this comparatively well-known microbe so often found in the upper air-tract of healthy people.

Before closing I wish to make mention of some investigations, as yet very incomplete, which I have been engaged upon during the last two months, more in the hope that

others with more leisure and better opportunities will continue them, than from an expectation of adding much to our knowledge. I refer to the nasal chambers as a bacterial filter of the air passing through them.

It has been definitely proved by the investigations of Grehant (30), Paulsen (31), Aschenbrandt (32), and Bloch (33) that the nasal chambers not only are warmers and moisteners of the inspired air, but act also as a filter for dust particles. The latter observer experimented with many substances in fine powder, and came to the following conclusion, as did Grehant and Aschenbrandt:

"A certain part of all kinds of dust, even the finest, is held back; the larger part of the formed substances which float in the air do not reach the entrance of the larynx or even the choanæ; but it is impossible for the nose, even with the help of the naso-pharynx, to *completely* free the air even from the coarser kinds of dust."

Now, a bacterium, whatever its relative proportions to other divisions of matter with which we are familiar, is a ponderable substance, heavier than air, water, or any of the animal fluids. It is therefore subject to the same physical laws. It is yet an unsolved mystery how the *Bacillus tuberculosis* reaches the most frequently chosen seat of its selective action in the apices of the lungs, and how the pneumococcus usually reaches the lower lobes before a lobar pneumonia occurs. To a bacteriologist it is almost inconceivable how a microbe entering the anterior nasal meatus with the tidal air should go through the tortuous, moist passage of the nose, past the broad surface of the palate and the post-pharyngeal wall, into the larynx between the false and true vocal cords, down the long tubes of the trachea and bronchi, and finally find a lodging place on the walls of the bronchioles and air cells. The chances of its being arrested before it reaches them seem almost infinite,

especially since the tidal air must stop at a comparatively high point in the respiratory channel in inspiration, and flow upward again on expiration. Neither does it seem probable that, becoming arrested at some higher point, it flows downward with the bronchial secretions, when we remember the ciliated epithelium and its function. The lymph channels have been strongly urged as an explanation; but, although our knowledge of the pulmonary lymphatics is very limited, there are many objections to this vague theory which will occur to every one. The day for theorizing has gone by. A theory nowadays should be considered as little better than confession of ignorance.

However small and insignificant an addition to our knowledge the ascertaining of the capacity of the nose as a place of arrest for microbes may be, it seemed so easy of demonstration that I have attempted it. The technical difficulties were many, but have been fairly overcome, though it needs a much more extended and varied research than I have yet made to draw conclusions. The task is easily stated: Ascertain the bacterial contents of the air before and after it has passed through the nose. Glass tubing, of a caliber of one eighth to one fourth of an inch and six inches long, was filled with granulated sugar for three inches and a half of its length, held in place at the bottom by a piece of rolled copper gauze, tightly fitting the tube, leaving enough space at each end for the insertion of a cotton plug. The sugar grains were of a uniform size of forty to the inch. This part of the apparatus was copied from that of Professor Sedgwick and G. R. Tucker, of Boston, to whom I am greatly obliged for a description of their method of air analysis kindly sent to the college laboratory some time before it was communicated to the Society of Arts, in whose proceedings for 1887–'88 it may be found. Their rules for sterilization of the sugar and the apparatus were also followed. For rea-

sons which I need not stop to explain here, it was found best to vary their procedure considerably and adopt, to some extent, the method of Petri (34) with sand. After proper sterilization, the glass tubing was attached by means of stiff rubber tubing to an air-exhaust apparatus. As there was a good head of water in the laboratory, a Sprengel's air-pump was principally used, by means of which one litre of air could be drawn through the three inches and a half of sugar in from forty seconds to a minute. Usually, however, a very perfect air-exhausting apparatus may be obtained by making use of the Allen surgical pump, of the size used for veterinary purposes. About a hundred revolutions of the handle of this instrument, which can be made in forty-five seconds or a minute, will exhaust one litre of air. With either contrivance it is perfectly easy to ascertain the rate at which air will pass by means of a litre flask inverted in water.

It has been proved by Sedgwick, and I have verified the statement, that air passing at about this rate will deposit all its bacterial contents in the sugar.

With this apparatus, then, ten litres of air are drawn through the filter after the cotton plugs used during sterilization have been withdrawn. Then ten litres of air at the same time and in the same locality are drawn through the nose and also through the filter. This is accomplished as follows: The glass tubing with its load of granulated sugar, all thoroughly sterilized, is inclosed by means of a perforated rubber cork in a larger piece of glass tubing and the space between the two loosely packed with absorbent cotton. The end of the smaller tube does not reach to the end of the larger. The filter thus protected from the buccal secretions is put into the mouth and the lips are closed firmly around the outside tubing. If it is held in a horizontal position in the mouth, nothing but air can enter the filter when the suction

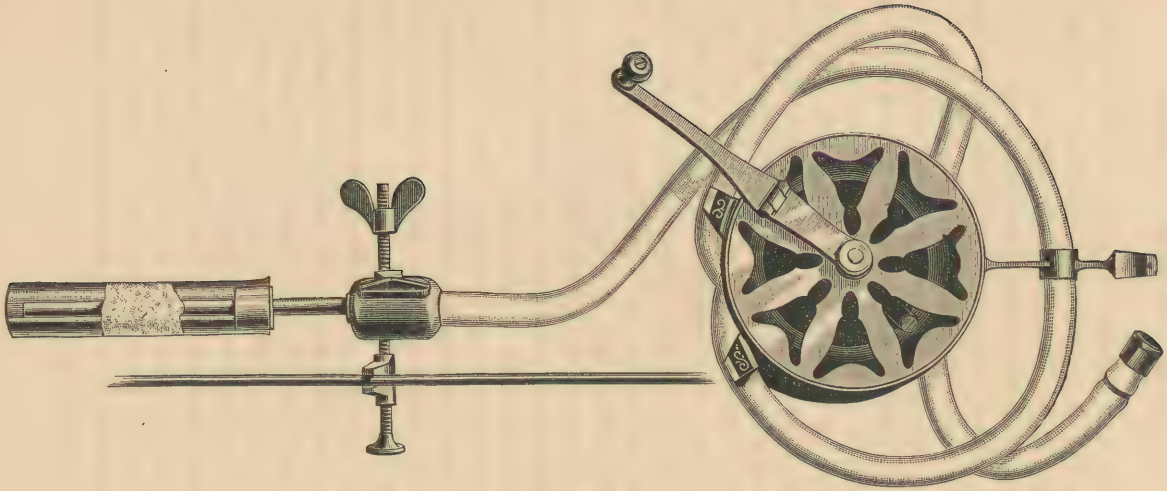


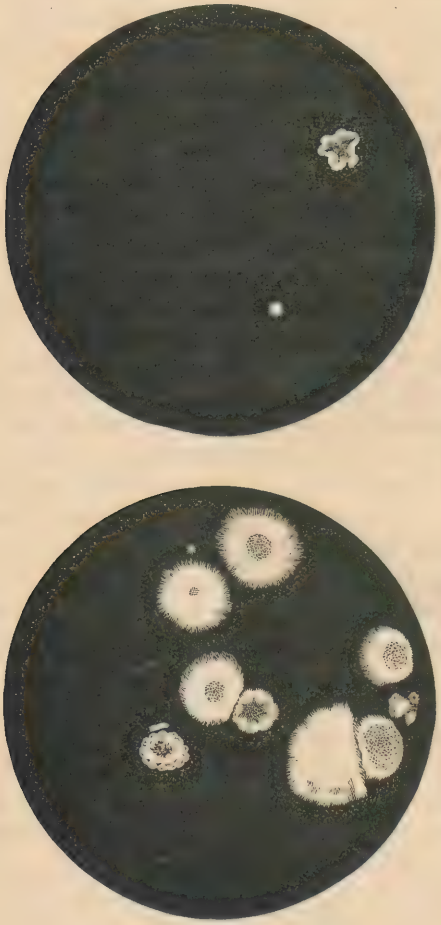
Fig. 1.

is begun. During alternate periods of fifteen seconds each the person is directed to hold his breath, making the thoracic walls rigid. Thus practically all the air drawn through the filter must have first passed through the nasal chambers and the post-nasal space. During the fifteen seconds of respiration the air current is shut off by compressing the rubber tube between the filter and the suction apparatus; consequently the time consumed in the examination of the nasal air is twice that consumed in the control examination. The plan adopted by Aschenbrandt and others of drawing the air up one nostril and down the other before examination, besides other faults, permits the entrance of mucus into the air filter, which it is impossible to protect from contact with the walls of the nasal chambers.

After the ten litres of air are drawn through in each case the sugar is dampened and partly dissolved with a few drops of carefully sterilized water to facilitate its removal from the glass tubing. By means of a sterilized stiff brass rod the wire gauze is pushed along the tubing, forcing the wet and partly dissolved sugar out into shallow glass dishes, where it is thoroughly dissolved and mixed with ten-per-cent. nutrient gelatin. The glass tubing is filled with gelatin and stopped at both ends with cotton. The gelatin in the dishes is allowed to solidify slowly so as to insure the complete dissolving of the sugar. It was found that very few, in many cases no, colonies developed in the glass tubing, so completely did the sugar carry along its bacterial contents with it when pushed out. I have described the process hurriedly and omitted descriptions of the routine precautions taken in sterilizing, controlling, and guarding against aerial contaminations, which belong to the technique of careful bacterial analysis.

The colonies developed after several days in the two sets of dishes were counted and compared. As I said before,

too few examinations were made to arrive at hard and fast conclusions. I only experimented on my own nose, and have succeeded only recently in getting results free from



Bacterial contents of ten litres of laboratory air after passing through the nose and the postnasal space.

Bacterial contents of ten litres of laboratory air.

FIG. 2.

errors of technique. Speaking in a general way, the nasal chambers in my own case seem capable of filtering out about three fourths to four fifths of the bacterial contents of the air passing at the rate of one litre a minute. The photographs of an examination made during the presence of a considerable quantity of mold in the air illustrate this fairly well. This particular experiment was photographed because the white molds show the difference in a more striking manner than bacterial colonies, but the same proportion seems to hold good with them, as, for instance, in an examination made on April 25th of this year.

Ten litres of laboratory air contained four molds and a hundred and twenty-five bacteria. Ten litres of laboratory air, after passing through the nose, contained one mold and twenty-four bacteria. Of course noses must differ in this respect as much as in other ways, and the rapidity of the current we know makes a difference in the number of both molds and bacteria deposited in Hesse's apparatus. Counting 500 c. c. as the tidal air with each inspiration, we have about nine litres a minute passing through the nasal chambers in normal respiration. In the experiments just mentioned the rate was only a little over one litre a minute. In spite, then, of the apparently well-adapted arrangement of the nasal chambers for a bacterial filter, even at this rate a really large number of bacterial forms are carried at least into the larynx. It is to be hoped that further and more complete and reliable investigations will confirm or refute this somewhat premature assertion. Unless we are to throw aside the very numerous and careful observations made by bacteriologists in pulmonary diseases as useless, it is surely of the greatest importance that we should know something of the mode of ingress of microbes into the deeper pulmonary tracts.

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